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In a study conducted at the University of Alberta, an attempt was made to use Piagetian-type observations as an assessment of intellectual capacities and to determine whether learning a second language at an early age has beneficial or detrimental effects on cognitive functioning. For this purpose an 18-question test dealing with conservation (awareness of invariance) and measurement of length was constructed. The six subtests and the questions used were similar to the tests used by Piaget and dealt with the following topics: reconstructing relations of distance, conservation of length, conservation of length with change and position, conservation of length with distortion of shape, measurement of length, and subdividing a straight line. According to Piaget the concepts represented by these subtests are dependent on each other and are acquired in a definite sequence. Fifty monolingual first grade children and 50 bilingual first graders were tested individually. The mean for the bilingual sample on the conservation test was significantly higher than the mean for the monolingual sample. The result here seems to be in agreement with Peal and Lambert's finding that bilingualism has favorable effects on intellectual functioning. (DO)

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BILINGUALISM AND CONSERVATION

W.W. Liedtke and L. D. Nelson

RELATED LITERATURE:

Various researchers and psychologists have dealt with the topic of bilingualism. In their attempt to test for the effects of bilingualism on intellectual functioning they have come up with and reported different and often contradicting results. Numerous studies are listed and discussed by Jensen (6). He points out that even though the majority of studies found that bilingualism was disadvantageous to a child's intellectual development, the opposite could be true since most of the results came from studies that used varying definitions of bilingualism, few subjects, and a great variety of procedures.

Peal and Lambert (7) review studies on bilingualism dating as far back as 1920. They conclude that the answers to the question whether monolingual and bilingual children differ in intelligence as measured on standardized tests fall into three categories:

1. Bilingualism has a detrimental effect on intelligence
2. There exists no significant difference between the two groups
3. Bilingualism has favorable intellectual consequences

In analyzing the studies, Peal and Lambert conclude that the contradicting results came from studies with little internal or external validity since bilingualism was often not defined and such important

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variables as socio-economic status, sex, educational background and age were not controlled. In a carefully controlled study these investigators tested the hypothesis that there exists no significant difference between monolinguals and bilinguals if all the important variables are controlled. They found that the bilingual subjects scored significantly higher on all verbal and most non-verbal parts of their tests. On none of the subtests did the monolinguals exceed the bilinguals. They used factor analysis to analyze the results and found that bilingual children had a greater number of separate independent abilities on which to draw in completing the tests. These subjects had developed more independent abilities and skills at an earlier age through their experiences and their learning of a second language. The structure of their intellect appeared to be more diversified than that of monolinguals. Wider experiences, greater mental flexibility, and superior verbal skills and fluency helped them to achieve better in school.

Jacobs and Pierce (5) in their study tested the relationship between bilingualism and creativity or divergent thinking. They compared a group of monolinguals with three groups of five different linguistic backgrounds. The "Word Meanings" and a "Uses" test were administered. The bilinguals scored considerably higher than the monolinguals and when the subjects were matched by quartiles according to I.Q. the difference in scores remained. These results seem to indicate that bilinguals exhibit a somewhat greater ability to think divergently, a characteristic not measured on intelligence tests.

THE PROBLEM:

Many of the studies discussed by Jensen, Peal and Lambert used standard intelligence tests for the basis of comparing monolingual and bilingual subjects. Much has been written and said about the inadequacy of this approach to intelligence assessment. Biggs notes that,

'frequently, intelligence is defined as the extent to which a given test measures a factor called *g*. However, *g* is nothing more nor less than a statistically derived construct..... it does not and cannot correspond to a "factor of the mind", ... that enters into all intellectual tasks'. (3:6). He also states that if different intelligence tests made up of different subtests were to be given to a child, the resulting I. Q. would not be the same for the child. Thus while traditional I. Q. testing has shown itself to be of considerable practical value, it does not tell us anything very much about the manner in which intelligence actually operates (3:89).

Sullivan (9:13-14) lists four major criticisms of the use of intelligence tests as an assessment of a child's intellectual capacity and intellectual strength. There is no clear-cut theoretical rationale for the items that appear on a test, the test is omnibus in make-up, wrong answers to items give no information about the child's cognitive maturity, and because of the stability of mental age scores at certain age levels, notions of fixed intelligence and predetermined development have been extrapolated from the data. He points out that several writers have hinted at the possibility of using Piaget's observations as an assessment of intellectual capacities. Piagetian-type tests, he argues, would be more than an empirical sampling at different age levels since the item placement receives its rationale from Piaget's theory of intellectual development. A test of this type is not an omnibus test and a wrong answer to an item gives as much information as a correct answer about the child's intellectual capacity. For example, permanence or conservation tasks, could be used to illustrate cognitive functioning at certain age levels.

According to Piaget, conservation or the awareness of invariance, under certain transformations, represents one of the most important components in the transition from intuitive thought to concrete operational

thought. Conservation is an intellectual ability that enables the child to interpret his environment more realistically. By testing for the concept of conservation in any particular area a close estimate of a child's stage or level of development can be found.

THE STUDY:

In a study conducted at the University of Alberta an attempt was made to use Piagetian type observations as an assessment of intellectual capacities and to determine whether learning a second language at an early age has beneficial or detrimental effects on cognitive functioning. For this purpose a test dealing with conservation and measurement of length was constructed. The six subtests and the questions used were similar to the tests used by Piaget (8:67-149) and dealt with the following topics: reconstructing relations of distance, conservation of length, conservation of length with change of position, conservation of length with distortion of shape, measurement of length, and subdividing a straight line. According to Piaget the 'concepts' represented by these subtests are dependent on each other and they are acquired in a definite sequence. Conservation of length is secured with the acquisition of the notion that a unit may be applied indefinitely in a continuous series of changes of position involving the synthesis of subdivision and change of position.

SAMPLES:

Two samples were selected from Edmonton schools for the investigation. One sample consisted of fifty monolingual children who were randomly selected from six grade one classrooms. These subjects had no functional knowledge of a second language, and only one language was spoken at home. The other sample consisted of fifty bilingual children

who attended grade one in three different classrooms. These subjects had used English and French before entering school, both languages were used at home, and they received instruction in both languages. The classroom teachers helped in selecting the bilingual subjects. Both samples consisted of twenty-five girls and twenty-five boys.

Data collected included information about each subject's birth date, intelligence (10), socio-economic status (4), and kindergarten or playschool attendance.

RESULTS:

Fifty-two per cent of the monolingual and seventy-four per cent of the bilingual subjects had attended either kindergarten or playschool. Since this difference was rather large, kindergarten attendance and the scores on the conservation test were correlated. The resulting coefficient (0.141) was not significant at the .05 level. In Table 1 the age, socio-economic status, and intelligence means for the two samples are compared.

TABLE 1

Age, S.E.S., and Intelligence Means for the Two Samples

	MEANS		
	MONOLINGUALS	BILINGUALS	t (CALCULATED)*
Age	6.85	6.82	0.435
Socioeconomic Status	49.16	49.56	0.265
Intelligence	107.40	104.22	1.325

* t(.05) = 1.985

The conservation test consisted of eighteen questions and it was administered individually to each subject. A one (1) was assigned for a correct response and a zero (0) for an incorrect one. The means, variances, and standard deviations were calculated and multiple linear regression analysis was used to analyze the results. The findings are summarized in Table 2.

TABLE 2

Analysis of Results for Conservation Test

	MEAN	VARIANCE	STANDARD DEVIATION
Monolinguals	10.72 *	13.88	3.72
Bilinguals	13.72 *	13.72	3.70
Total Group	12.22	15.76	3.97

* $F\text{ - Ratio}_{(1,94)} = 16.04$

$F_{.05\quad(1,94)} = 3.95$

DISCUSSION:

According to Piaget, each child passes through developmental stages. These stages follow an invariant sequence. However, he claims that, 'movement through these stages can be accelerated by the child's environmental experiences'. (9:14). The forces Piaget (2) hypothesizes to explain the process of development are: maturation, experience with the environment, socialization, and the process of equilibration. Of these, experience with the environment and socialization would make developmental acceleration possible.

The mean for the bilingual sample on the conservation test was significantly higher than the mean for the monolingual sample. Since

the presence of conservation is an indicator of functioning at the level of concrete operations, the above result could imply that the level of cognitive functioning is more advanced in the bilingual subjects even though the results of the standardized intelligence test (Table 1) didn't give this indication. The result here seems to be in agreement with Peal and Lambert's finding that bilingualism has favorable effects on intellectual functioning.

Piaget and his collaborators (1:40) have indicated that the age at which a child attains conservation is in part a function of the experience he has had. Bilingual children bring with them an enriched linguistic and cultural experience and the evidence presented here would seem to demonstrate the importance of social interaction and social environment as part of experience.

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